
Kamakou Preserve

Moloka'i, Hawai'i

Long-Range Management Plan

Fiscal Years 2007–2012

Submitted to the
Department of Land & Natural Resources
Natural Area Partnership Program

Submitted by
The Nature Conservancy of Hawai'i

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EXECUTIVE SUMMARY

The Nature Conservancy of Hawai‘i is the Hawai‘i Chapter of The Nature Conservancy, an international private, non-profit organization based in Arlington, Virginia. The Conservancy’s mission is to preserve plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Since 1980, the Hawai‘i program has established a statewide system of 12 preserves totaling 32,000 acres, and has helped protect another 8,600 acres in privately-owned preserve lands. Working with the federal government, we have helped acquire 150,000 acres for national wildlife refuges and parks. Today, we are taking conservation to a new level in Hawai‘i by protecting the larger landscapes and biological systems of which these preserves are a part. Together with other public and private landowners, we are protecting almost 1 million acres of ecologically important lands through voluntary, cooperative partnerships that allow landowners to share expertise and resources and work across ownership boundaries.

The State’s Natural Area Partnership Program (NAPP) is an innovative program that aids private landowners in the management of their native ecosystems. NAPP provides matching funds (\$2 state to \$1 private) for the management of qualified private lands that have been permanently dedicated to conservation. On Moloka‘i, the Conservancy manages three NAPP Preserves: Kamakou, Mo‘omomi, and Pelekunu, and is the main coordinator/manager of the East Moloka‘i Watershed Partnership (EMoWP) which is directly responsible for management programs in Kamalō, Kapualei, and Kawela. The three NAPP preserves total 9,454 acres and the EMoWP (including Kamakou and Pelekunu Preserves) encompasses over 30,000 acres. Kamakou was approved for NAPP funding in 1995. This long-range management plan updates an earlier plan covering fiscal years (FY) 2001–2006 and was prepared in compliance with the Natural Area Partnership agreement between the State and The Nature Conservancy of Hawai‘i. This plan documents management programs to be undertaken in the next 6 years (FY2007 – FY2012) at Kamakou Preserve.

The State Department of Land and Natural Resources (DLNR), which administers the NAP program, is kept apprised of our progress in the preserve through written reports and an annual inspection. Operational plans are submitted annually (the Conservancy has adopted a July 1 – June 30 fiscal year). In addition, a six-month update is sent to DLNR each January. These documents are available upon request to others who are interested.

The first section of this plan is a brief overview of the native resources that are protected at Kamakou Preserve. In the second section are management considerations that have shaped our programs. Finally, each management program is discussed in turn. Program goals are followed by an explanation of the management method we have chosen and a brief summary of each program’s past accomplishments. Objectives for each program from FY2007 – FY2012 are also listed. A projected budget is included for each year.

RESOURCE SUMMARY

General Setting

Kamakou Preserve (Figure 1) was established in September of 1982 to protect the habitat of endemic forest birds. The 2,774-acre preserve is located in the east Molokaʻi mountains and borders five other protected natural areas: state-owned Puʻu Aliʻi Natural Area Reserve (NAR), Kalaupapa National Historical Park, Kawela Plantation common lands, Kamalō/Kapualei Watershed Project, and the Conservancy's Pelekunu Preserve. These managed areas belong to the East Molokaʻi Watershed Partnership (Figure 2) and protect more than 25,000 acres of contiguous ecosystems that range from sea level to 4,970 feet in elevation. Kamakou is one of the primary ground water recharge and surface water source areas feeding the State Department of Agriculture's Molokaʻi Irrigation System. The preserve is open to the public for hiking and hunting, and for educational and cultural activities. During times of extreme fire hazard, unsafe road conditions, or herbicide spraying in accessible areas, portions or all of the preserve may be closed to the public.

Flora and Fauna

Kamakou Preserve contains five vegetation zones (Figure 3), which contain ten natural community types, ranging from lowland mesic (moist) shrublands to montane wet forests. There are two rare natural communities (Appendix 1): the ʻŌhiʻa Mixed Montane Bog community and the Montane Wet Piping Cave (known only from Molokaʻi). The preserve's more common natural communities (Appendix 1) are also found in Olokuʻi, Puʻu Aliʻi NARs, and the Kamalō/Kapualei watershed project.

Kamakou is home to 40 rare plant taxa, 23 of which are listed endangered. Fourteen of Kamakou's 40 rare plants have also been reported from Olokuʻi and/or Puʻu Aliʻi NARs, and 7 of the preserve's rare plant taxa have been reported in Kalaupapa National Historical Park (Appendix 2).

Of the five native forest birds historically known from Kamakou since 1960, only ʻapapane (*Himatione sanguinea sanguinea*) and ʻamakihi (*Hemignathus virens wilsoni*) are seen frequently. In FY1996, a solitary juvenile ʻiʻiwi (*Vestiaria coccinea*) was seen in the preserve and three occurrences of ʻiʻiwi were recorded in FY2004 during the 2004 Molokaʻi Forest Bird Project survey. The kākāwahie (Molokaʻi creeper, *Paroreomyza flammea*) has not been seen on Molokaʻi since 1963, and the olomaʻo (Molokaʻi thrush, *Myadestes lanaiensis rutha*) has not been seen on Molokaʻi since 1988 (one was sighted in Kamalō, just east of the preserve) (Appendix 3).

Although much more remains to be learned about the molluscan fauna, five species of rare native land snails have been reported in Kamakou Preserve (Appendix 4). Two of these have been the subject of long-term population dynamics and evolutionary research led by the University of Hawaiʻi's Dr. Michael Hadfield. In FY1996, Dr. Hadfield's project suffered a major setback when the snail population decreased significantly due to rat predation. In response, we acquired funds from the U.S. Fish and Wildlife Service for emergency management of the snails. We are

Figure 1. Kamakou Preserve

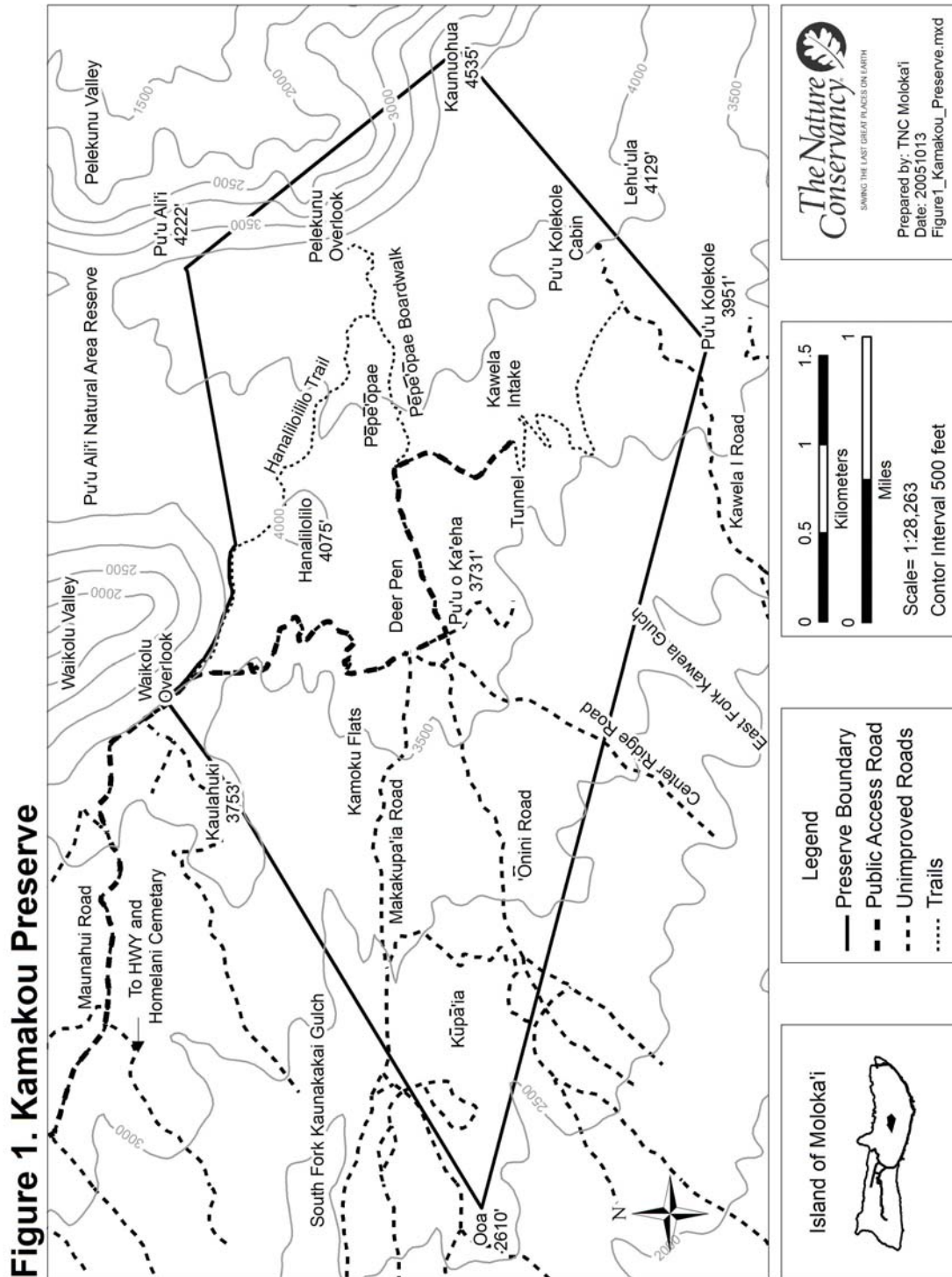


Figure 2. East Moloka'i Watershed Partnership

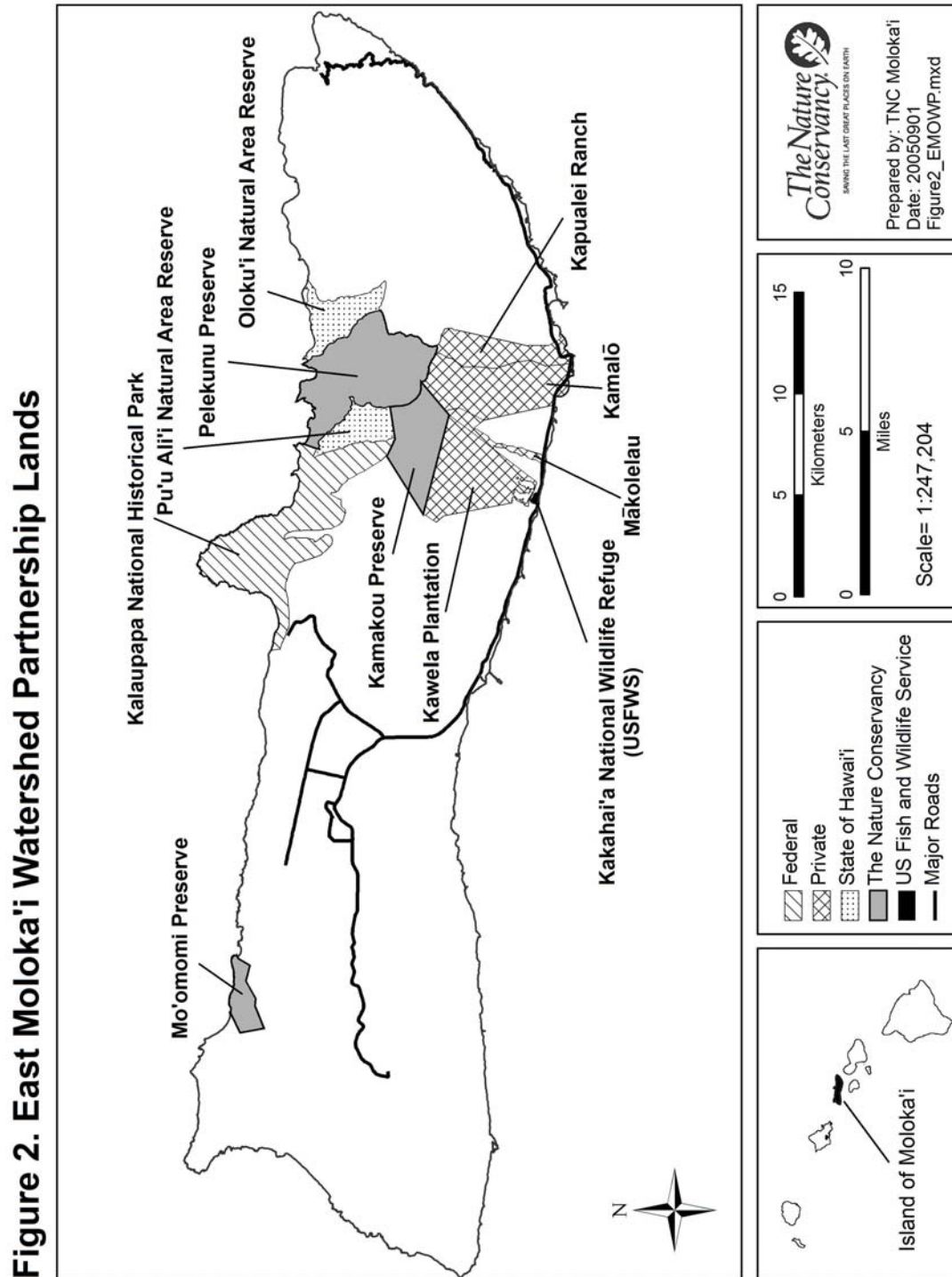
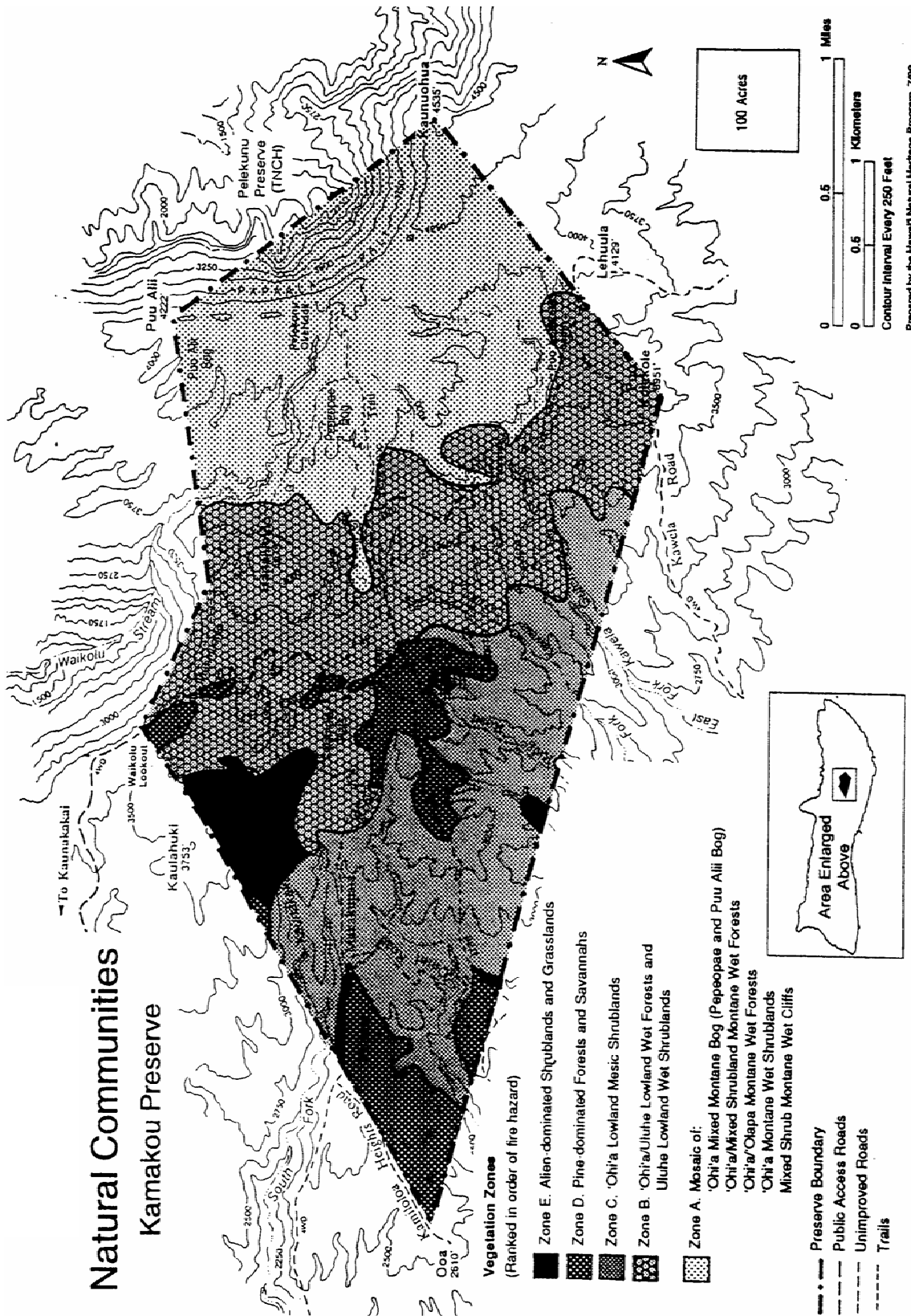


Figure 3. Kamakou Preserve Natural Communities



controlling the rat population through an intensive rat baiting program, which will continue until the threat is eliminated and the tree snail population is considered stable.

MANAGEMENT

Management Considerations

1. Our primary management activities for protecting the preserve's native plants, animals, and natural communities are to reduce feral ungulate damage, limit the spread of non-native, habitat-modifying plants, and prevent wildfire. We are also committed to continuing community outreach and to providing continued access for people who want to use the preserve in ways that will not degrade its natural resources. The Conservancy continues to provide access to the extent required by law for the purpose of allowing traditional practices in the area. In general, visitor use is expected to increase over the next 6 years and accommodations may need to be made to deal with potential negative impacts due to the increased usage levels.
2. Prior to 1982, the Kamakou Preserve area was part of the State's Moloka'i Forest Reserve under a surrender agreement with the landowner, Moloka'i Ranch, Ltd. In 1982, the Conservancy purchased a permanent conservation easement over the property from Moloka'i Ranch. This easement ensures the Conservancy's rights to manage the preserve for the benefit of native species and ecosystems, and prohibits a wide range of potentially unsuitable activities by the landowner. The document also reserves certain rights for the landowner, including the right to enter and inspect, and to harvest surface water from the established water development systems, which may be expanded within clear limits described in the easement. The Nature Conservancy began an easement compliance monitoring program in FY2005. This monitoring is done annually in order to ensure that The Nature Conservancy and Moloka'i Ranch are in compliance with the terms outlined in the conservation easement.
3. The surrender agreement between the State and Moloka'i Ranch expired in FY2002 and is currently being negotiated. The preserve's status as part of the Moloka'i Forest Reserve depends upon these negotiations. The State Division of Forestry and Wildlife (DOFAW) in the past has provided wildfire suppression, road maintenance, use of Pu'u Kolekole cabin, and assistance with other projects in the preserve. A Master Cooperative Agreement and Memorandum of Understanding between DOFAW and the Conservancy encourages sharing of staff, equipment, and expertise. Through a Memorandum of Understanding with DLNR, the preserve's main access road is part of the Na Ala Hele trail and access system.
4. Designated areas of the preserve are open for public hunting (see Status of Public Hunting Opportunities on page 9), hiking, and for educational and cultural activities. During times of extreme fire hazard, unsafe road conditions, or herbicide spraying in accessible areas, portions or all of the preserve may be closed to the public. Notification of closure will be made via a sign posted on the forest access road near the Maunawainui Bridge and/or by announcements in local newspapers.

5. Access into many parts of the preserve is relatively good via a number of dirt roads and trails. Most were developed in the early 1900s as part of Moloka'i Ranch's water system and for the state's reforestation programs. Management facilities include the Pu'u Kolekole cabin and the old Civilian Conservation Corps barracks along the Maunahui Road (outside the preserve). The Conservancy leases the barracks from the state on a monthly revocable basis.
6. The Conservancy programs across the nation are currently undergoing conservation action planning which is a proven process for developing conservation strategies and measuring the effects of those strategies. The planning approach utilizes the "Five S's": systems, stresses, sources, strategies, and success. Our assessment included which conservation targets occurred at the preserves and the natural processes that maintain them. The targets that have been selected for East Moloka'i include: North Shore Forests and Cliffs, Montane Wet Forest, South Slope Mesic Forest and Shrubland, North Shore Perennial Streams, North Shore Coastal Strand, North Near Shore Marine Systems, and South Shore Fringing Reef. Our conservation goal at this site is to maintain viable occurrences of the conservation targets. This is accomplished by developing and implementing conservation strategies to abate the critical sources of stress and directly restore or enhance the native ecosystems.
7. In June 2003, the U.S. Fish and Wildlife Service designated a portion of the preserve as a "critical habitat" for the endangered Blackburn's Sphinx Moth (*Manduca blackburni*). This designation requires the Service to consult under Section 7 of the Endangered Species Act with regard to actions carried out, funded, or authorized by a federal agency (see <http://pacificislands.fws.gov/CHRules/mothfinal.pdf>).
8. Since 1996, the Conservancy has worked with the State Division of Forestry and Wildlife and the Kalaupapa National Historical Park to leverage efforts over four natural areas: Kamakou, Pelekunu, Pu'u Ali'i, and Oloku'i. In 1999, our "partner" effort was formalized and expanded through the East Moloka'i Watershed Partnership. The management of ungulates through the leveraging of partner efforts is critical, especially because feral ungulates know no boundaries. We will continue to dedicate time to the control of ungulates outside our boundaries and to help with the overall ungulate problem in the natural areas of East Moloka'i. In April 2001, the partnership completed a five mile long contour fence in the neighboring Kamalō/Kapualei ahupua'a. Funds have been secured to extend the fence through Kawela and connect it to the Kamakou east boundary fence. This fence will provide a barrier from the large goat herds that have created a browse line at about the 3,000' contour. In April 2003, Kawela Plantation Homeowners Association KPHA (through their Board) signed the EMoWP MOU making KPHA an official partner. Additionally, KPHA signed a Memorandum of Agreement with the Conservancy to manage their upper "common lands". Using funds from the U.S. Fish and Wildlife Service, the Conservancy coordinated grading a total of 10.2 miles of existing roads in the Kawela "common lands". These road repairs increase access for hunting activities and provide much needed fire breaks in this area. Progress on the EMoWP is reported to funders annually (Attachment 1).

Management Programs

Although the following management programs are described separately, they form an integrated management approach. For each program listed in the following section, we have indicated a major goal and described the management methods chosen. Also included are highlights of past and current achievements and key management issues. Finally, key objectives to achieve the goal are listed by year for FY2007 – FY2012.

Program 1: Non-Native Species Control

Ungulate Control

Program Goal: To keep ungulate activity below designated thresholds.

After several years of open public hunting, we installed snares in the preserve's remote units from 1990 to 1992 to control feral ungulate populations. During the snaring program, transect data for single monitoring sessions showed that the average of ungulate (goat, pig, and deer) activity (fresh, intermediate, and old sign) along remote transects declined from over 30% in October 1990 and February 1992 to less than 10% ungulate activity in the latter half of 1992 and February 1993. In FY1993, to address the concerns of community hunters, we removed all snares and began (and are maintaining) community hunting as our primary method of ungulate control. The Moloka'i Hunting Working Group (MHWG) (formed in 1993, formally known as the Moloka'i Hunting Test Working Group) provides a forum for allowing community input on issues that affect land managers, hunters, and other Moloka'i community resource users. The MHWG agreed to use the results from our already established monitoring program to determine the success of community hunting in the preserve. At the September 29, 1999 meeting of the MHWG it was agreed to change the criteria for measuring success of community hunting to a threshold of 10% (a yearly average) for all ungulate activity preserve wide. Prior to that meeting the preserve was split into remote and non-remote sections, with different criteria for each section.

In November 2001, staff began testing a live pig trap at Kamakou. After some trial and error with setting the trap and modifying it so that pigs were not able to escape, we began to have successful captures in September 2002. Macadamia nuts are used for bait. There are currently 3 live pig traps that are set and periodically moved to locations with high pig activity.

In addition to hunting and trapping, we also use 4-foot-tall hog wire fences to protect fragile areas and to control pig and goat movement. To date, we have constructed four fences (Figure 4). The "Pu'u Ali'i" fence, built by the Conservancy for the state NAR program under contract, extends from east to west, south of Pu'u Ali'i Bog. Another fence encircles Pu'u Ali'i Bog. A third fence extends from the rim of Pelekunu Valley west toward Pēpē'ōpae Bog and is about 1,000 feet long. The fourth fence is 2 miles long, was built using EPA non-point source pollution funds, and is located along the east boundary of the preserve. A fifth fence (discussed in Management Consideration 8) is planned that will connect the Kamakou east boundary fence to the Kamalō/Kapualei fence. Over the next six years we anticipate the need for additional fencing

along the southern boundary of the preserve, the exact length and location will be determined by the impact of the fifth fence on ungulate movement.

We plan to continue to use community hunting combined with live pig traps and strategic fencing as our primary methods of ungulate control at Kamakou. It has been difficult to achieve the agreed upon ungulate threshold levels using the current control methods, therefore methods will be periodically reevaluated and new methodologies will be explored as they become available.

Ungulate Control Timeline and Costs

Years 1 - 6 (FY2007 – FY2012)

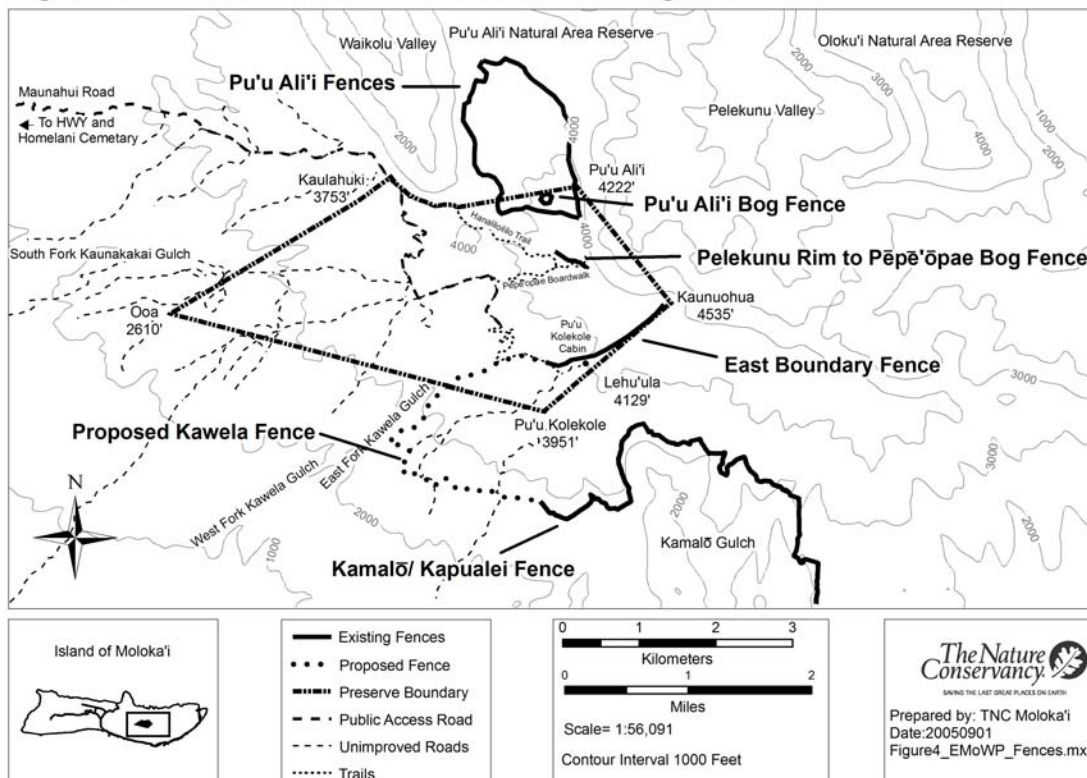
- Continue community hunting program with emphasis on increasing hunting pressure to hold activity below agreed upon levels and, based on results of semi-annual ungulate monitoring sessions, modify strategies as needed.
- Repair existing fences as needed.
- Construct and maintain southern boundary fence.
- Support research on ungulate control techniques.
- Continue live pig trapping.
- Conduct Conservancy-led volunteer hunts as needed in areas with high ungulate activity.

Status of Public Hunting Opportunities

The preserve is open for public hunting where and when this is compatible with management programs, and in accordance with the regulations of the adjoining state Pu‘u Ali‘i NAR. At this time, the NAR and the preserve are open year-round to hunting of pigs, goats, and axis deer, without a bag limit. During times of extreme fire hazard, unsafe road conditions, or herbicide spraying in areas accessible to the public, portions or all of the preserve may be closed.

Figure 4. Kamakou Preserve Management Areas and Fences

Figure 4. Kamakou Preserve And EMoWP Ungulate Fences



Weed Control

Program Goal: Improve or maintain the integrity of native ecosystems in selected areas of the preserve by reducing the effects of alien plants.

Habitat-modifying weeds are non-native plants that are known to alter natural habitat conditions and displace native vegetation. Displacement is accelerated by ungulate disturbance. Ungulates, especially pigs, impact the ground by their foraging activities (rooting and digging) and also spread unwanted weed seeds. Fire also accelerates invasion by certain weed species. Control of ungulates and wildfire, therefore, are among the most effective means of controlling the introduction and spread of habitat-modifying weeds in the preserve.

In Kamakou, weeds are controlled manually (by pulling or cutting), chemically (using herbicides), or with a combination of manual and chemical control methods. Volunteers provide about half of the labor needed for manual weed removal. Herbicides are used only on serious weeds that cannot be controlled by other means and by field staff trained in their safe application. We consult the State Department of Agriculture and University of Hawai'i College of Tropical Agriculture and Human Resources regarding the types of herbicides used and their

proper application. Furthermore, we require all supervisory field staff to be certified in restricted pesticide application through the state Department of Agriculture. A third way to control weeds is by using biological control agents. We are required to obtain approval from the Conservancy's Worldwide Office to release state-approved biological control agents. If we decide that biocontrol is needed in Kamakou, we will collaborate with state and federal biological control programs to ensure that this technology is appropriately applied.

In addition to active management of established weeds, our weed control program also focuses on prevention. For example, staff and visitors follow strict procedures to prevent the inadvertent introduction of alien pests while working or hiking in the preserve. Our alien species prevention protocol calls for inspecting all clothing and equipment for alien seeds and invertebrate pests such as ants before they are taken into the preserve. We also support the efforts of the Molokai Invasive Species Committee (MoMISC) which is discussed further in the Outreach section of this plan.

The Pēpē'ōpae Boardwalk is an invaluable site to show residents and visitors Moloka'i's native forest in a way that minimizes damage to this resource. The Boardwalk was originally installed in 1985 and completed in 1990. In addition to regular maintenance, it is important for staff to continuously monitor and control weeds along the boardwalk that people transport on their shoes and carry further along the trail.

Weed Control Timeline and Costs

Years 1 - 6 (FY2007 – FY2012)

- Manually remove known populations of *Clidemia hirta* along grid transects quarterly. Scout for new populations outside of defined grid area. Collect GPS coordinates for all new populations and update GIS maps.
- Scout for, map, and remove populations of karakanut (*Corynocarpus laevigata*), prickly Florida blackberry (*Rubus argutus*), black wattle (*Acacia mearnsii*), strawberry guava (*Psidium cattleianum*), New Zealand flax (*Phormium tenax*), and rose (*Rosa* sp.).
- Treat outlying populations of white ginger (*Hedychium coronarium*).
- Eliminate Christmas berry (*Schinus terebinthifolius*) from within the preserve boundaries.
- Scout for incipient invasive weeds and the spread of other priority weeds.
- Conduct annual alien grass control along the main preserve roads in the fall (Sept.) to prevent their spread by vehicles.
- Control weeds, such as meadow rice grass (*Ehrharta stipoides*), *Juncus*, and vasey grass (*Paspalum urvillei*), that grow along the Pēpē'ōpae boardwalk to prevent the spread of weeds into the adjoining native areas.
- Work with cooperating agencies and landowners to maintain a response protocol for dealing with incipient populations of alien pests on Moloka'i, including Conservancy preserves, as needed.
- Recruit and maintain volunteer pool to provide a minimum of 300 person hours of weed control per year.
- Update weed priority list as needed using systematic evaluation of weed distribution, availability of control methods, and the weeds' disruptive potential. See Appendix 5 for a list of priority weeds at Kamakou Preserve.
- Scout for, map, and control *Tibouchina herbacea* within the preserve boundaries.

Program 2: Monitoring and Research

Program Goal: To track the biological resources and critical threats in the preserve, and evaluate changes in these resources and threats to guide management programs.

Monitoring

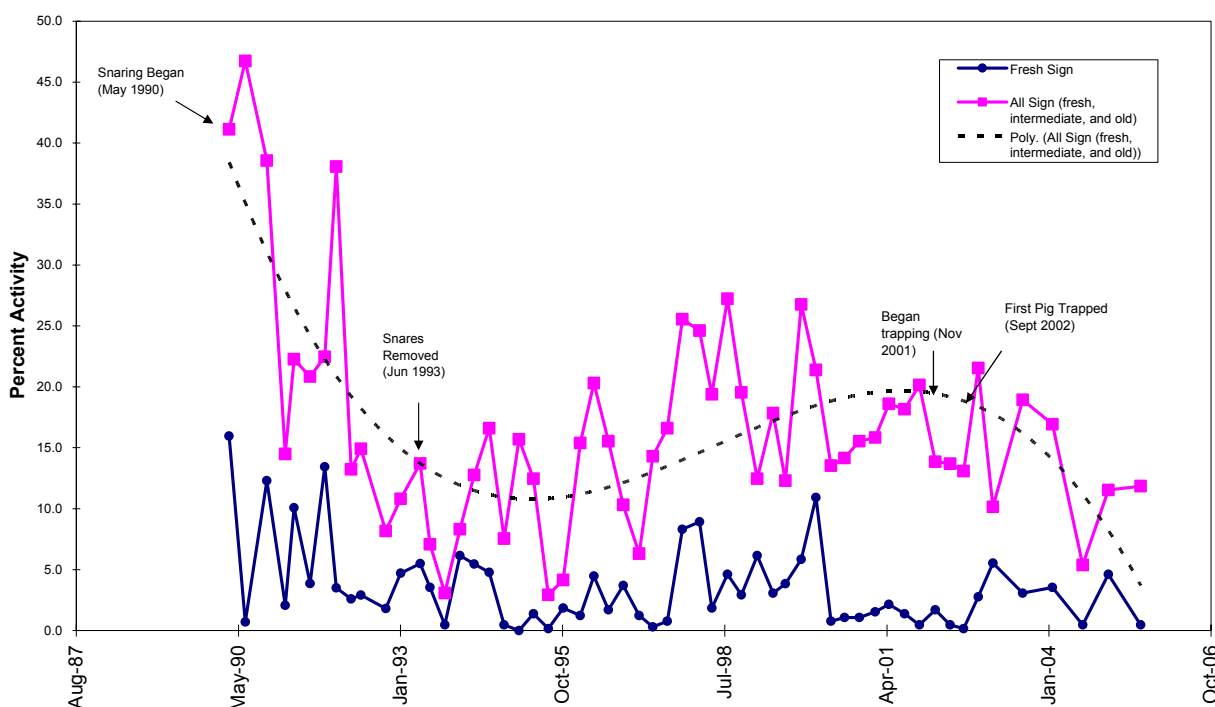
The purpose of monitoring is to help track important biological resources and critical threats over time to identify trends or changes. Measuring whether threats are reduced and viability is maintained or improved is extremely difficult. And yet, we must try to determine if our actions are having the intended effect and if we are spending our limited resources wisely. Science staff conducted a comprehensive one year review of monitoring in the preserve and for the East Moloka'i landscape. The Kamakou Monitoring Plan (Table 1) reflects those results. Two types of monitoring will occur: 1) Threat factors including the four most critical threats to the preserve (non-native ungulates, habitat modifying weeds, new invasive animal and plant species, and wildfires); 2) Key attributes of the native ecosystems (extent of ecosystem, adjacent land use to native ecosystems, condition of the vegetation canopy, and condition of the vegetation understory).

Table 1. Kamakou Monitoring Plan

CRITICAL THREAT MONITORING	INDICATORS
1. Ungulate activity	<ul style="list-style-type: none"> Frequency of ungulate sign (reported annually)
2. Extent of habitat-modifying weeds	<ul style="list-style-type: none"> (Still under development)
3. New invasive plants & animals	<ul style="list-style-type: none"> Number of priority incipient, invasive species kept off the island (reported annually) Number of discovered or reported incipient, invasive species eradicated (reported annually)
4. Extent of wildfires	<ul style="list-style-type: none"> Acres of native ecosystem burned within the preserve (reported annually) Miles of firebreak that protect the preserve (reported every 3 years in FY2007 and FY2010) Number of hours between reporting & containment (reported in years with fire)
BIOLOGICAL RESOURCE MONITORING	
Landscape Context	
5. Connectivity to native or protected areas	<ul style="list-style-type: none"> Percent of ecosystem boundary adjacent to lands managed for threat reduction or biodiversity conservation (reported every 5 years, information provided by HI GAP in FY2007 and FY2012)
Condition	
6. Vegetation canopy condition along USFWS transects in preserve	<ul style="list-style-type: none"> Percent of native canopy cover (reported every 8 years, rotate transects 2 per year, see Appendix 6 for schedule and details)
7. Vegetation understory condition along USFWS transects in preserve	<ul style="list-style-type: none"> Percent of native understory and/or ground cover (reported every 8 years, rotate transects 2 per year, see Appendix 6 for schedule and details)
8. Diversity of indicator plant species along USFWS transects in preserve	<ul style="list-style-type: none"> (Still under development)
Size	
9. Extent of ecosystem	<ul style="list-style-type: none"> Acres of ecosystem (reported every 5 years, information provided by HI GAP in FY2007 and FY2012)

In general, our ungulate monitoring data has provided us with the information we need to guide our management efforts. In 1984 a series of 8 transects were set up in the preserve to measure ungulate activity¹. Since then we have expanded to a total of 13 transects. We monitor semi-annually for signs of ungulate activity in contiguous 5m X 10m plots along 500m-long transects. This monitoring method is used to gauge the effectiveness of our control strategies and techniques (Figure 5).

Figure 5. Ungulate Activity in Kamakou (All Transects)



Weed monitoring is most problematic. We are working toward developing a monitoring system that will more tightly link our weed control management actions with effective monitoring. The details for this new system have not yet been determined.

Data regarding new invasive plant and animal introductions will be provided by MoMISC and the information kept in a database that the Conservancy and MoMISC are working cooperatively to maintain.

Information regarding the extent of wildfires in the preserve and miles of firebreaks cleared are recorded as they occur.

We began preserve-wide vegetation monitoring in FY1994 and completed it in FY1995, using permanent plots to collect data on plant species composition, distribution, abundance, and foliar cover. Science staff decided to discontinue vegetation monitoring methodology developed in

¹ "Ungulate activity" is determined by monitoring belt transects for presence or absence of ungulate signs (e.g., tracks, scat, wallows, evidence of browsing). For example, if ungulate sign(s) are present in 10 out of 100 transect stations, the activity level is said to be 10%.

FY1994 because it was overly detailed and not applicable for management purposes. Our goal over the next six years is to develop and implement a simple yet effective assessment of the native vegetation that will include analysis of aerial imagery for the entire landscape (managed and unmanaged areas), as well as implementation of an efficient ground-based, rapid assessment method. We will be testing rapid vegetation monitoring along U.S. Fish and Wildlife Service transects during the first several years of this plan.

Support will be provided as able for additional monitoring efforts conducted by other agencies such as the Hawai'i Forest Bird Project and survey which was conducted on Moloka'i in 1979, 1988, 1989, 1995, and 2004. Staff provided logistical support and labor during FY2004 to assist with the completion of the same transects done in 1995.

Research

The Conservancy encourages research that will help us better understand and thereby, protect the preserve's resources. Conservancy funding for research is limited. Therefore, whenever possible, we provide logistical assistance to approved research projects by other agencies or individuals. We would like Kamakou to remain a major research site for studies dealing with conservation and protective land management in Hawai'i. See Attachment 2 for a list of research conducted at Kamakou Preserve.

On August 23, 1998, a fire started on the SW flank of the mountains of East Moloka'i. In the preserve, the fire burned in 'Ōhi'a (*Metrosideros*) Lowland Mesic Shrubland (ranked G3 by HINHP), in tree plantations comprised of pine (*Pinus* spp.), and in small plantings of alien trees. A three-year study of the burned shrubland was initiated one month after the fire and was designed to accomplish three goals. First, we documented the types of plants and rate at which they re-colonized the burned areas. Second, we quantified the invasion of burned and unburned shrublands by invasive, non-native molasses grass. Third, we assessed the amount of erosion that was likely to occur in the badly burned areas. Results showed a rapid recolonization of the area by molasses grass (*Melinis minutiflora*), and over a dozen other weed species, many of which were not originally present in the unburned shrubland. The molasses grass cover may have been responsible for the lack of measurable erosion at the burn site. Three applications of a grass-specific herbicide slowed the growth of molasses grass, but it did not eliminate the grass cover entirely. Three years after the fire, no native seedlings were able to reestablish above the molasses grass, and the former shrubland appears to have been converted to alien grassland. No remediation or restoration of the burned area is planned. Survey will be conducted again in FY2012 (September 2011) to determine if conditions have changed a decade after the fire.

Monitoring and Research Timeline and Costs

Years 1 – 6 (FY2007 - FY2012)

- Conduct semi-annual ungulate activity surveys and analyze data to determine effectiveness of control program.
- Develop and implement weed monitoring system.
- Maintain MoMISC database to track number of priority incipient, invasive species kept off the island and track the eradication of incipient species from the island.

- In years that fires occur, maintain records of acres of native ecosystem burned within the preserve and number of hours between reporting & containment.
- Maintain Kamalō/Kapuālei weather station and collect data.
- Provide logistical assistance for approved research and apply research conclusions as warranted to management activities.
- Update Appendix 6 with new information on native canopy cover completing 2 transects per year.
- Develop and implement monitoring method to measure diversity of indicator plant species along USFWS transects in preserve.

Additional Year 1 (FY2007)

- Record current baseline miles of firebreak that protect the preserve.
- Compile baseline information from Hawaii Gap Analysis Program (HI GAP) on the percent of ecosystem boundary adjacent to lands managed for threat reduction or biodiversity conservation and acres of ecosystem.

Additional Year 4 (FY2010)

- Record miles of any additional firebreaks created.

Additional Year 6 (FY2012)

- Resurvey 1998 shrubland burn plots.
- With information from HI GAP, update record of the percent of ecosystem boundary adjacent to lands managed for threat reduction or biodiversity conservation and acres of ecosystem.

Program 3: Rare Species Protection

Program Goal: To prevent extinction of rare species in the preserve.

To date, 40 rare plant taxa, 3 bird species listed by the state and/or federal government as endangered, and 5 rare snail species have been reported from the preserve (Appendices 2–4). The Conservancy uses data compiled by the Hawai‘i Natural Heritage Program to identify rare taxa, and uses their definition of rare: “species that exist in fewer than 20 populations or less than 3,000 individuals worldwide.” In FY1996, an ‘i‘iwi was seen in Kamakou for the first time in five years. In April 2004, an ‘i‘iwi was again observed during the forest bird survey. These reports are very encouraging and have initiated discussions by the State about developing an ‘i‘iwi recovery plan. (The Moloka‘i and O‘ahu ‘i‘iwi populations are considered endangered by the state of Hawai‘i.)

Currently, there are 3 rare species enclosures (*Phyllostegia manii*, *Stenogyne bifida*, *Platanthera holochila*) that were created in response to outside request. Over the next six years, we will develop strategies to identify key rare plant species that would be appropriate to reintroduce back into the preserve. Any reintroduction will be located within fence enclosures for protection from grazing animals. We will work cooperatively with neighboring land owners and managers to develop strategies for areas adjacent to the Preserve.

As part of our rare species management, we have relocated a number of rare plant populations and collected information on their status (see “Management Plan for the Protection of 10 Rare Plant Species on Moloka‘i”). Threats to these plants were also assessed. We will continue to assist researchers that monitor these populations on a regular basis (e.g., Genetic Safety Net project). Monitoring includes mapping the plants (by getting GPS coordinates and mapping on standard USGS quads) and collecting information on surrounding terrain and vegetation. Descriptions of each rare plant population, which includes each plant’s size, reproductive status, vigor, and any obvious threats are also recorded. The Conservancy cooperates with the Hawai‘i Rare Plant Restoration Group and the Center for Plant Conservation. These groups developed rare plant monitoring forms and guidelines in 1998. We are using the standardized forms and forwarding monitoring data to the Hawai‘i Natural Heritage Program in Honolulu.

In FY1997, we observed a steep population decline of rare *Partulina redfieldi* tree snails in Snail Meadow. In response, we initiated an intensive rat baiting program that is still in progress. In a mark-recapture study conducted on April 24-25, 2000, the number of live *Partulina redfieldi* found in the five study trees was more than double the count of the last trip in June 1999, indicating that these populations were recovering and that the rat-baiting program was successful. In July 2003, the number of tree snails dropped to 37% of the population number found in December 2000 due in part to rodent predation. We continue to bait this area on a monthly schedule and will increase baiting effort if rodent bait take exceeds monthly allotments.

Rare Species Protection Timeline and Costs

Years 1 - 6 (FY2007 – FY2012)

- Maintain baiting program as necessary to control rats within the entire Snail Meadow management area to protect *Partulina redfieldii* for as long as needed.
- Maintain the *Platanthera holochila* fence enclosure and survey the plants within them annually.
- Maintain *Stenogyne bifida* enclosure, survey the area for weed threats annually, and control weeds as needed.
- Coordinate seed and fruit collection of critically endangered plants for ex-situ propagation with Lyon Arboretum or National Tropical Botanical Garden (NTBG). Assist approved researchers with rare species monitoring and apply management recommendations when appropriate.
- Collaborate with partners to develop and implement a plan to reintroduce the yellow wiliwili, and possibly other native plants to Mo‘omomi Preserve.

Program 4: Community Outreach

Program Goal: To build community support and awareness concerning the conservation of native natural resources, and to implement effective conservation practices that are also culturally sensitive.

The Conservancy's Moloka'i community outreach programs go far beyond the boundaries of any single conservation site; therefore there is considerable overlap in our community outreach program among the three preserves. Outreach activities at each preserve affect the community's overall perception of the Conservancy and the importance of preserving Moloka'i's native natural resources. This overlap is reflected in our report for this section.

We have taken a multi-faceted, comprehensive approach towards community outreach on Moloka'i. The Nature Conservancy has evolved from being a site specific conservation manager, to an organization that does conservation on a landscape scale. Moloka'i's population is around 7,000 and the outreach activities help educate the community about the importance of preserving Moloka'i's natural resources and the Conservancy's role in managing those resources.

We work with a variety of conservation partners, schools, community groups, government and private funders, employment training organizations and programs, and individual volunteers and volunteer groups.

- ◆ Hō'ikaika (since 2001) and AmeriCorps (since 1999) are year round federal work experience programs that provide young adults as volunteers. In exchange, the Conservancy provides conservation sites for practical, hands-on training.
- ◆ Internships (since 1984), summer workers from Alu Like (since 1987), the State Summer Youth Employment Program (since 1993) and internships from the Natural Resources Academy (NaRA) (since 2004) also provide young adults hands-on experience in natural resource conservation.
- ◆ Moloka'i Advisory Council (since 1993), Moloka'i Hunting Working Group (since 1993), and Kamalō Conservation Advisors (since 2001) are community groups that we engage in program decision making.
- ◆ Ke Aupuni Lōkahi (Moloka'i Enterprise Community "EC" Board) (since 1999), The Moloka'i Water Working Group (MWWG) (since 1993), and Watershed Advisory Group (WAG) (since 2002) are examples of the Conservancy's involvement with Community-wide decision making entities. Ke Aupuni Lōkahi began a strategic planning process that led to the formation of the EMoWP (which the Conservancy is a partner) as part of its broader goal to develop island wide community resources to stimulate the local economy yet retain its rural atmosphere. MWWG plays an advisory role to the State Water Commission's mandate of water allocation and projections. WAG is helping the State Department of Health assess and implement strategies to remedy non-point source pollution (water quality/sedimentation) on Moloka'i's south shore and reefs.
- ◆ We conduct monthly guided hikes at Kamakou and Mo'omomi Preserves (the Kamakou hike includes a scenic overlook into Pelekunu, and provides an opportunity for us to teach hike participants about Pelekunu's important stream ecosystem), and work with the public schools

to provide conservation/environmental education through field trips and slideshows.

Moanalua Gardens Foundation is a key environmental education partner on Moloka‘i.

- ◆ Produce a quarterly newsletter, called “*Nature’s Newsflash*”, that is mailed to every address on Moloka‘i to inform the local community about conservation news and activities on Moloka‘i.
- ◆ On Moloka‘i our annual “big” event is the Moloka‘i Earth Day Celebration. Earth Day Celebration is a way of bringing together conservation agencies/organizations to display their mission and accomplishments to the local community. The event is interactive and to provides basic environmental education to the public. The event draws at least 10% of Moloka‘i’s population.
- ◆ Our volunteer program continues to grow and includes individuals, school groups (Moloka‘i Environmental Preservation Organization – MEPO a Moloka‘i High and Intermediate School club), trained hike docents, outer island weekend groups, and local Moloka‘i hunters and groups.
- ◆ In October 2000, the Conservancy staff initiated and coordinated a new partnership called the Moloka‘i subcommittee of the Maui Invasive Species Committee (MoMISC). The goal of the subcommittee is to prevent introduced invasive pests from becoming established or widespread on Moloka‘i. MoMISC activities include response to reports of invasive pests, containment of selected incipient pests, creating educational material, and public outreach. MoMISC collaborates on a state-wide level with other island Invasive Species Committees and the Coordinating Group on Alien Pest Species (CGAPS). A weed database was created for more efficient tracking and landscape mapping of the Conservancy’s and MoMISC’s weed control activities. In cooperation with MoMISC and the State Department of Agriculture we are working to increase the public’s awareness of invasive alien species, through local community events (Earth Day Celebration), brochures, posters, and our quarterly issued bulk mailed newsletter, *Nature’s Newsflash*. Our immediate goal is to teach members of the community to identify and report key invasive species that are not yet established on Moloka‘i [e.g. *Miconia calvescens*, fountain grass (*Pennisetum setaceum*), Asian clam (*Corbicula fluminea*), Caribbean frog (*Eleutherodactylus coqui*), gorse (*Ulex europaeus*), brown tree snake (*Boiga irregularis*), pampas grass (*Cortaderia jubata*)].

Community Outreach Timeline and Costs

Years 1 – 6 (FY2007 – FY2012)

- Maintain AmeriCorps federal volunteer programs to provide support for field operations.
- Select and fund annual Moloka‘i High School summer intern (cost reflected in personnel).
- When feasible, train and oversee Alu Like and other Summer Youth Program participants in management activities throughout the summer months.
- Continue to engage community groups (MAC, MHWG, and Kamalō Conservation Advisors) in program decision-making; organize/recruit new groups as necessary.
- Continue to participate in MWWG, Ke Aupuni Lōkahi, and WAG.
- Conduct monthly and special community group hikes at Kamakou and Mo‘omomi Preserves.
- Continue production and distribution of *Nature’s Newsflash*.
- Coordinate and organize annual Moloka‘i Earth Day Event.
- Maintain and develop docent and volunteer participation and conduct training sessions as needed.
- Cultivate active participation of Moloka‘i Earth Preservation Organization (MEPO) in the

protection of Moloka‘i native natural resources (e.g. weed control trips, restoration of native ecosystems). Encourage MEPO to develop goals to become a source of native plants for re-vegetation.

- Support MoMISC (Moloka‘i Subcommittee of Maui Invasive Species Committee) activities.

Program 5: Fire Management

Program Goal: To protect the natural resources in Mo‘omomi Preserve from fires in and around the preserve.

Wildfire Management Plans for all three preserves are updated annually and reviewed with the lead state or county emergency response agency. Operational plans for all three preserves are updated annually and sent to neighboring landowners and agencies.

Dirt roads provide the main access to Mo‘omomi Preserve and also provide fire breaks. Roads and trails are maintained to provide safe access to and within the preserve.

Activities

- Update Wildfire Management Plan.
- Update staff fire suppression training.
- Purchase equipment as needed to allow immediate response to fire threats.
- Respond to emergencies or fire threats.
- Maintain preserve roads as needed.

BUDGET SUMMARY

The following table summarizes the six-year budget for Kamakou Preserve. Through the NAP program, the state pays two-thirds of the management costs outlined in this long-range plan.

The Conservancy’s Moloka‘i operations maintain a full time base staff of 6. Other part-time, short-term, or year-to-year personnel are hired periodically as project needs warrant. An estimated 60% of Moloka‘i base personnel, office/baseyard, travel and general operating costs and 80% of vehicle costs are funded by the Kamakou budget.

Technical and annual planning support is provided by the Honolulu office of the Conservancy. In particular, the Conservation Programs Director, Conservation Programs Coordinator, Conservation Planner, Senior Scientist, and other island resource staff help prepare annual plans and reports, develop and implement monitoring and research programs, and establish interpretive and intern programs at the preserve.

Two preserve facilities are associated with Kamakou Preserve. The Kamakou barracks is a state-owned building in the Moloka‘i Forest Reserve that is leased by the Conservancy to house volunteers and researchers. The Pu‘u Kolekole cabin, inside the eastern boundary of the preserve, is also state-owned. The Conservancy uses this cabin for management and research

activities in the eastern portion of the preserve.

This budget includes an annual 4% increase for personnel costs (including benefits), annual site inspection travel expenses for a DLNR employee, NAP renewal costs such as an environmental assessment and cultural assessment, and vehicle expenses both as equipment purchases and equipment leases. The Conservancy routinely provides trainings for staff to improve job performance, and in addition to these trainings, supervisory staff will attend regular meetings in Honolulu. Travel and training funds are included within this budget to cover airfare, board and lodging, and training expenses. An overhead rate is included (subject to slight change each year) to recognize the Conservancy's indirect costs for personnel, accounting, legal, and other administrative support. Although the Conservancy's overhead rate is currently 22%, the NAP program will currently pay only 10%, leaving the remainder as a portion of the Conservancy's one-third match.

Kamakou NAPP							
	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	TOTAL
Labor and Fringe	180,000	187,200	194,688	202,476	210,575	218,998	1,193,936
Supplies/Equipment	52,100	24,100	48,100	74,100	52,100	24,100	274,600
Travel (includes helicopter)	11,200	11,200	11,200	11,200	11,200	11,200	67,200
Subcontracts	-	-	-	-	-	10,000	10,000
Other	38,046	34,290	34,290	34,290	31,076	28,780	200,772
<i>Subtotal</i>	<i>281,346</i>	<i>256,790</i>	<i>288,278</i>	<i>322,066</i>	<i>304,951</i>	<i>293,078</i>	<i>1,746,508</i>
Overhead @ currently negotiated rate	61,896	56,494	63,421	70,854	67,089	64,477	384,232
TOTAL	343,242	313,284	351,699	392,920	372,040	357,555	2,130,740
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Kamakou Budget	343,242	313,284	351,699	392,920	372,040	357,555	2,130,740
Private Match (1/3 of total)	114,414	104,428	117,233	130,973	124,013	119,185	710,247
TOTAL NAPP REQUEST (2/3)	228,828	208,856	234,466	261,947	248,027	238,370	1,420,493

APPENDIX 1 **NATIVE NATURAL COMMUNITIES OF KAMAKOU PRESERVE**

NATURAL COMMUNITY	GLOBAL RANK(a)
Lowland	
‘Ōhi‘a/Uluhe (<i>Metrosideros/Dicranopteris</i>) Lowland Wet Forest ^{1,2}	G3
Uluhe (<i>Dicranopteris</i>) Lowland Wet Shrubland ^{1,2}	G4
‘Ōhi‘a (<i>Metrosideros</i>) Lowland Mesic Shrubland	G3
Montane	
‘Ōhi‘a/‘Ōlapa (<i>Metrosideros/Cheirodendron</i>) Montane Wet Forest ^{1,2}	G3
‘Ōhi‘a (<i>Metrosideros</i>) Mixed Montane Bog	G2
‘Ōhi‘a (<i>Metrosideros</i>) Mixed Shrub Montane Wet Forest ^{1,2}	G3
‘Ōhi‘a (<i>Metrosideros</i>) Montane Wet Shrubland	G3
Mixed Shrub Montane Wet Cliffs	G3
Aquatic Community	
Hawaiian Continuous Perennial Stream	G1
Hawaiian Intermittent Stream ^{1,2}	G4
Subterranean Community	
Small-eyed Rock Centipede/Ground Beetle (<i>Lithobius/Carabid</i>) Montane Wet Piping Cave	G1

1 =Known also from Pu‘u Ali‘i NAR

2 =Known also from Oloku‘i NAR

(a) Key to Global Ranks as defined by the Hawai‘i Natural Heritage Program, Aug. 2001:

G1 = Critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.

G2 = Imperiled globally; 6-20 occurrences and/or 1,000-3,000 individuals remaining; or more abundant but facing serious threats range-wide.

G3 = Moderately imperiled globally; 21-100 occurrences and/or 3,000-10,000 individuals remaining; or more abundant but facing moderate threats range-wide; or restricted in range.

G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern.

APPENDIX 2
RARE NATIVE PLANTS OF KAMAKOU PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
<i>Adenophorus periens</i> [<i>Oligadenus periens</i>]		G1	LE
<i>Alectryon macrococcus</i> var. <i>macrococcus</i> ³	‘ala‘alahua, māhoe	G1T1	LE
<i>Bidens wiebkei</i>	ko‘oko‘olau, kōko‘olau	G1	LE
<i>Canavalia Molokaiensis</i> ³	‘āwikiwiki, puakauhi	G1	LE
<i>Clermontia oblongifolia</i> ssp. <i>brevipes</i> ¹	‘ōhā, ‘ōhā wai	G3T1	LE
<i>Cyanea mannii</i>	‘ōhā, hāhā, ‘ōhā wai	G2	LE
<i>Cyanea procera</i> ¹	‘ōhā, hāhā, ‘ōhā wai	G1	LE
<i>Cyanea solanacea</i> ^{1,2}	‘ōhā, hāhā, ‘ōhā wai, pōpolo	G1	SOC
<i>Cyanea solenocalyx</i> ^{1,2}	‘ōhā, hāhā, ‘ōhā wai	G2	SOC
<i>Cyrtandra halawensis</i> ²	ha‘iwale, kanawao ke‘oke‘o	G1	SOC
<i>Cyrtandra hematos</i> ²	ha‘iwale, kanawao ke‘oke‘o	G1	SOC
<i>Cyrtandra macrocalyx</i>	ha‘iwale, kanawao ke‘oke‘o	G2	SOC
<i>Diellia erecta</i>	-	G1	LE
<i>Dissochondrus biflorus</i>	-	G2	SOC
<i>Eurya sandwicensis</i> ^{1,2}	ānini	G2	SOC
<i>Exocarpos gaudichaudii</i> ³	heau	G1	SOC
<i>Hedyotis mannii</i> ³	-	G1	LE
<i>Joinvillea ascendens</i> ssp. <i>ascendens</i> ²	‘ohe	G5T1	C
<i>Lobelia dunbariae</i> ssp. <i>paniculata</i>	‘ōhā, hāhā, ‘ōhā wai	G1T1	SOC
<i>Lobelia hypoleuca</i>	‘ōpelu, liua, mo‘owahie	G3	
<i>Lysimachia maxima</i> ¹		G1	LE
<i>Mariscus fauriei</i>	-	G1	LE
<i>Melicope hawaiiensis</i>	alani	G2	SOC
<i>Melicope mucronulata</i>	alani	G1	LE
<i>Melicope reflexa</i>	alani	G1	LE
<i>Nothocestrum latifolium</i>	‘aiea	G1	C
<i>Phyllostegia hispida</i> ¹		G1	C*
<i>Phyllostegia mannii</i> ¹	-	G1	LE
<i>Phyllostegia pilosa</i> ⁴	-	G1	(LE)
<i>Phyllostegia stachyoides</i>	-	G1	SOC
<i>Plantago princeps</i> var. <i>laxiflora</i> ^{2,3}	ale	G2T1	LE
<i>Platanthera holochila</i>	-	G1	LE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
<i>Ranunculus mauiensis</i> ^{1,3}	makou	G2	C
<i>Schiedea diffusa</i>	-	G1	SOC
<i>Schiedea nuttallii</i>	-	G1	LE
<i>Schiedea sarmentosa</i>	-	G1	LE
<i>Sicyos cucumerinus</i>	‘ānunu, kūpala	G1	SOC
<i>Stenogyne bifida</i> ¹	-	G1	LE
<i>Vigna o-wahuensis</i>	-	G1	LE
<i>Zanthoxylum hawaiiense</i> ³	hea‘e, a‘e	G1	LE

Number of Rare Plants in Kamakou: 40

1 = Also known (currently or historically) from Pu‘u Ali‘i NAR

2 = Also known (currently or historically) from Oloku‘i NAR

3 = Also known (currently or historically) from Kalaupapa National Historical Park

4 = Formerly known as *Phyllostegia mollis*.

(a) Key to Global Ranks as defined by the Hawai‘i Natural Heritage Program, Aug 2001:

G1 = Critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.

G2 = Imperiled globally; 6-20 occurrences and/or 1,000-3,000 individuals remaining; or more abundant but facing serious threats range-wide.

G3 = Moderately imperiled globally; 21-100 occurrences and/or 3,000-10,000 individuals remaining; or more abundant but facing moderate threats range-wide; or restricted in range.

G5 = Demonstrably widespread, abundant, and secure.

T1 = Subspecific taxa critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.

(b) Federal Status:

LE = Taxa formally listed as endangered.

SOC = Taxa that available information does meet the criteria for concern and the possibility to recommend as candidate.

C = Taxa for which substantial information on biological vulnerability and threat(s) support proposals to list them as endangered or threatened.

APPENDIX 3
RARE NATIVE BIRDS OF KAMAKOU PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
<i>Myadestes lanaiensis rutha</i>	Oloma‘o, Moloka‘i thrush	GHTH	LE
<i>Paroreomyza flammea</i>	Kākāwahie, Moloka‘i creeper	GH	LE
<i>Vestiaria coccinea</i>	‘I‘iwi	G4T1	SE,-

(a) Key to Global Ranks as defined by the Hawai‘i Natural Heritage Program, Aug 2001:
G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern.
GH = Historical. No recent observations, but there remains a chance of rediscovery.
T1 = Subspecific taxa critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.
TH = Subspecific taxa historical. No recent observations, but there remains a chance of rediscovery.

(b) Federal Status:
LE = Taxa formally listed as endangered.
SE = Moloka‘i population considered endangered by the state only.
- = No federal status.

APPENDIX 4
RARE LAND SNAILS OF KAMAKOU PRESERVE

SCIENTIFIC NAME	COMMON NAME	HERITAGE RANK (a)	FEDERAL STATUS (b)
<i>Partulina mighelsiana</i> ^{1,2}	Achatinellid Land Snail	G1	SOC
<i>Partulina proxima</i> ¹	Achatinellid Land Snail	G1	SOC
<i>Partulina redfieldii</i> ¹	Achatinellid Land Snail	G1	SOC
<i>Partulina tessellata</i> ^{1,2}	Achatinellid Land Snail	G1	SOC
<i>Perdicella helena</i>	Achatinellid Land Snail	G1	SOC

1 = Also known (currently or historically) from Pu‘u Ali‘i NAR

2 = Also known (currently or historically) from Oloku‘i NAR

(a) Key to Global Ranks as defined by the Hawai‘i Natural Heritage Program, Aug 2001:

G1 = Critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.

(b) Federal Status:

SOC = Taxa that available information does meet the criteria for concern and the possibility to recommend as candidate.

APPENDIX 5

PRIORITY WEED SPECIES OF KAMAKOU PRESERVE

(in order of priority)

Scientific Name	Common Name	DP	MA	DIS	EXP	Rank *
<i>Tibouchina herbacea</i>	glorybush	1	1	1	1	4
<i>Clidemia hirta</i>	Koster's curse	1	1	1	1	4
<i>Corynocarpus laevigata</i>	karaka nut	2	1	1	1	5
<i>Rubus argutus</i>	prickly Florida blackberry	1	1	2	1	5
<i>Schinus terebinthifolius</i>	Christmas berry	1	2	1	1	5
<i>Acacia mearnsii</i>	black wattle	2	1	1	2	6
<i>Passiflora</i> sp.	passion fruit, passion flower	3	1	1	1	6
<i>Psidium cattleianum</i>	strawberry guava, waiawī	1	2	3	1	7
<i>Hedychium coronarium</i>	white ginger	1	1	3	2	8
<i>Phormium tenax</i>	New Zealand flax	2	2	3	1	8
<i>Rosa</i> sp.	rose	3	1	2	2	8
<i>Syzygium jambos</i>	rose apple	2	4	1	1	8
<i>Eucalyptus robusta</i> (satellite pop'n)	swamp mahogany, eucalyptus	3	3	2	1	9
<i>Melaleuca quinquenervia</i>	paperbark	3	1	2	3	9
<i>Acacia melanoxylon</i>	blackwood acacia	3	1	3	3	10
<i>Fraxinus uhdei</i>	tropical ash	1	3	4	2	10
<i>Grevillea robusta</i>	silk oak	2	3	3	2	10
<i>Pinus</i> spp. (satellite pop'n)	loblolly, slash, Monterey pines	3	1	4	2	10
<i>Casuarina equisetifolia</i>	ironwood	2	3	3	3	11
<i>Opuntia ficus-indica</i>	pānini, prickly pear cactus	4	1	1	5	11
<i>Paspalum conjugatum</i>	Hilo grass	2	2	3	4	11
<i>Syncarpia glomeratus</i>	turpentine tree	3	3	2	3	11
<i>Toona ciliata</i>	Australian red cedar	2	5	2	2	11
<i>Alnus nepaliensis</i>	Nepal alder	3	3	3	3	12
<i>Grevillea banksii</i>	kāhili flower	3	3	2	4	12
<i>Psidium guajava</i>	common guava	3	3	2	4	12
<i>Traepoleus majus</i>	nasturtium	3	3	2	4	12
<i>Tristania confertus</i>	brush box	3	3	3	3	12

DP = disruptive potential

MA = methods available

DIS = distribution

EXP = experience

* DP+ MA+ DIS+ EXP = RANK

Scientific Name	Common Name	DP	MA	DIS	EXP	Rank *
<i>Andropogon virginicus</i>	broomsedge	2	3	5	4	14
<i>Lantana camara</i>	lantana	3	4	3	4	14
<i>Cupressus macrocarpus</i>	Monterey cypress	3	4	3	4	14
<i>Melinis minutiflora</i>	molasses grass	1	5	5	3	14
<i>Ageratina riparia</i>	Maui pāmakani	3	2	5	5	15
<i>Cryptomeria japonica</i>	tsugi, Japanese cedar	4	5	1	5	15
<i>Eucalyptus robusta</i> (plantings)	swamp mahogany, eucalyptus	3	3	5	4	15
<i>Ricinus communis</i>	castor bean	3	4	3	5	15
<i>Thuja plicata</i>	Western red cedar	4	5	2	4	15
<i>Ageratina adenophora</i>	Hamakua pāmakani	3	3	5	5	16
<i>Cunninghamia lanceolata</i>	China fir	5	5	1	5	16
<i>Hibiscus elatus</i>	Cuba blast	5	5	1	5	16
<i>Pinus</i> spp. (plantings)	loblolly, slash, Monterey pines	2	4	5	5	16
<i>Rubus rosifolius</i>	Thimbleberry	3	3	5	5	16
<i>Cirsium vulgare</i>	bull thistle	4	4	4	5	17
<i>Buddleia asiatica</i>	dog tail	3	5	5	5	18
<i>Juncus effusus</i>	Japanese mat rush	3	5	5	5	18
<i>Sequoia sempervirens</i>	coast redwood	5	5	3	5	18

DP = disruptive potential

MA = methods available

DIS = distribution

EXP = experience

APPENDIX 6

Vegetation Canopy and Understory Monitoring Protocols and Schedules

(still under development)